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The Effect of Training Age of Under-19 Football Players on Some Physiological Variables of the Cardiocirculatory System (Heart Rate - Blood Pressure)

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Abstract

This study aimed to identify the effect of training age on some physiological variables of the cardiovascular system, namely resting heart rate, post-exercise heart rate, and post-recovery heart rate for one minute, as well as systolic and diastolic blood pressure during the same periods, in under-19 football players. The researcher used the descriptive method with correlation and comparison techniques, as it was suitable for the nature of the study. To confirm the problem and its existence, the researcher conducted a pilot study, which showed that players with more training age had a better understanding of heart rate levels and training loads, as evidenced by their heart rate and its variations during training phases, compared to those with less training age.

To verify the validity, reliability, and objectivity of the tests and measurements used in the study, the researcher conducted a pilot study on a random sample of 19 players. The results showed that the tests demonstrated a high degree of validity, reliability, and objectivity.

In the main study, the researcher used a sample of 98 players under 19 years of age, representing 8 teams from the east, west, central, and southern regions of Skikda province. These players were selected purposively. The researcher relied on physiological measurements and physical tests in the main study. The physiological measurements consisted of measuring heart rate and systolic and diastolic blood pressure at rest, immediately after exertion, and finally after a one-minute recovery period.

The results showed that...

- Differences exist between under-19 football players according to their training age groups in functional variables (resting heart rate).

- Differences exist between under-19 football players according to their training age groups in functional variables (heart rate and systolic blood pressure after exertion).

- Differences exist between under-19 football players according to their training age groups in functional variables (diastolic blood pressure after exertion).

Keywords: *Sports Training, Football, Training Age, Cardiovascular System, Heart Rate, Blood Pressure, Under-19 Age Group.*

Introduction

Modern football is characterized by speed and power and is played in confined spaces, making limiting the space available to opponents a prominent feature of matches. Therefore, players must master a diverse

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range of motor skills to adapt to these conditions, in addition to possessing a high level of technical skill and strong physical conditioning to meet the demands of the modern game. This requires coaches to prepare players in all aspects, whether physical, technical, tactical, or psychological and mental.

George Cazorla (2006) stated that there is a strong and solid relationship between physiology and training in football, as a result of physiology's interest in studying the physiological changes that occur in the player's body as a result of performing physical training, which may be done once or as a result of continuous training and repeating training doses several times with the aim of improving bodily responses and developing the functional efficiency of the different body systems of the football player according to the modern requirements of training (Cazorla, G.2006.p81).

These requirements are linked to physiological aspects, through monitoring heart rate (pulse), blood pressure, vital capacity, and blood lactate concentration. It is well known that training and the use of daily training units lead to physiological and chemical changes within muscle cells, with the aim of providing the energy necessary for the player's performance. Since a player's level depends largely on their aerobic and anaerobic physiological capabilities, as well as the extent to which the chemical changes and developments occurring in their body contribute to the adaptation of various bodily systems to enable the player to perform at their best. Many coaches have benefited from the application of physiological tests as an essential part of any football training program. Measuring a player's physical exertion, in addition to measuring the components of physical fitness and physiological capabilities, has become the foundation upon which coaches rely to develop players' physical, technical, and tactical performance. This is all thanks to the science of sports physiology, which studies the changes and adaptations that occur in the body's systems as a result of physical exertion and is concerned with interpreting how the body performs its functions during athletic activity. This includes studying the functions of organs and cells from the cellular level up to the body as a whole. By observing the changes that occur during physical exertion, as well as other internal changes that can only be detected through specialized physiological and medical examinations, it becomes clear that it is crucial for a coach to be fully aware of the physiological aspects of players, such as heart rate, blood pressure, and recovery capacities, as these are fundamental to developing performance levels. Furthermore, a coach must be able to conduct physiological tests and measurements on players and interpret the results, as these measurements form the basis for developing training programs. How can we expect a football coach to improve their players' performance without a thorough understanding of the physiological variables that influence it? This highlights the importance of our study and its role in shedding light on the role of physiology in guiding sports training through key indicators for adjusting training programs and loads.

The Problem: Football is a sport characterized by a large number of non-periodic (1200) and unpredictable movements, occurring every 3 to 5 seconds, both during activity in general and competition in particular. These movements include 30 to 40 short-distance sprints, more than 700 turns, and 30 to 40 jumps. Analyses using a semi-automated video-based system have shown that top-level footballers perform 2 to 3 km of high-intensity running (over 15 km/h) and 0.6 km of short-distance running (over 20 km/h). In addition, the game requires other high-intensity movements such as kicking, dribbling, and tackling. All these efforts increase the physical stress on players and contribute to making the activity extremely physiologically demanding (Laia et al., 2009, pp. 291-306).

Physical preparation is a fundamental element in modern football, whether integrated, linked, or independent. Based on this principle, we must precisely understand the physical condition of modern football players during competition. This allows for training to be tailored to their actual needs (Dellal, 2015, p. 14). One of the advantages of modern training is its focus on integrated work, encompassing not only technical and tactical aspects but also physical and psychological ones (Cazzorla, 2016, p. 56).

To properly guide the training process, attention is given to the changes occurring at the cellular, tissue, and organ levels. This includes changes that contribute to the production of energy necessary for athletic activity. This advancement in physiological understanding contributes to raising the efficiency of athletes' physical performance by improving the body's response to physical training demands. Therefore, it has become essential to know heart rate and blood pressure levels and utilize them to adjust and measure

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training loads, leveraging these fundamental factors to ensure optimal adaptation to the requirements of athletic training.

Studies have also confirmed that the cardiovascular system is significantly affected by training, with blood pressure and heart rate exhibiting clear cyclical changes (Mager & Souissi, 2015, p. 1269). Furthermore, changes in heart rate are directly linked to the circadian rhythm, varying throughout the day or at different intervals (Vasan et al., 2017, p. 207). The results of the exploratory study showed that players with more training experience have a greater understanding of their heart rate levels at rest, after exertion, and after recovery. All of this data highlights the importance of studying physiological variables, particularly those of the cardiovascular system, due to their crucial role in guiding the training process, especially for young athletes, both during training and competition. Therefore, we ask: To what extent does training experience affect certain physiological variables of the cardiovascular system in football players under 19 years of age?

To answer this general question, we pose the following sub-questions:

1. Does training age affect resting heart rate and systolic and diastolic blood pressure?

2. Does training age affect resting heart rate and systolic and diastolic blood pressure immediately after exertion?

3. Does training age affect resting heart rate and systolic and diastolic blood pressure after recovery?

Research Objectives

This research aims to:

1. Determine the effect of football training on resting heart rate, post-exercise heart rate, and incomplete recovery in players under 19 years of age.

2. Determine the effect of football training on resting systolic blood pressure, post-exercise heart rate, and incomplete recovery in players under 19 years of age.

3. Determine the effect of football training on resting diastolic blood pressure, post-exercise heart rate, and incomplete recovery in players under 19 years of age.

Research Hypotheses

This research hypothesizes the following:

Hypothesis 1: There are statistically significant differences in resting heart rate, post-exercise heart rate, and post-incomplete recovery heart rate among football players under 19 years of age, based on their training age.

Hypothesis 2: There are statistically significant differences in resting systolic heart rate, post-exercise heart rate, and post-incomplete recovery heart rate among football players under 19 years of age, based on their training age.

Hypothesis 3: There are statistically significant differences in resting diastolic heart rate, post-exercise heart rate, and post-incomplete recovery heart rate among football players under 19 years of age, based on their training age.

Research Methodology

The researcher adopted the descriptive method using correlational and comparative studies, as it was suitable for the nature of the research. The descriptive method is considered "a method for describing and

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quantifying the phenomenon under study by collecting standardized information about the problem, classifying it, analyzing it, and subjecting it to rigorous study." (Slatania & Jilani, 2012, p. 133)

Study Sample: The research sample was selected purposively, and it included 98 players under the age of 19 representing 8 teams from the east, west, central, and southern regions of Skikda province.

Table No. (01) Shows the Distribution of the Main Study Sample

Category	The Team	Naming	numbre
Under 19 years old	Team 20 August 1955	CRMS	22
	Team Hamrouch Hammoudi	CAHH	25
	Team Najm Beni Oulbane	NRBBO	25
	Team Widad Ramadan Jamal	WARD	26
Total			98

characteristics of the sample: The results are shown in the following table:

Table No. (02) shows the characteristics of the research sample.

Weight (kg)		Height (cm)		Training age (years)		Age (years)		numbre	The team	Number of training days	Category
S	**X**	**S**	**X**	**S**	**X**	**S**					
4,952	63,596	3,816	172,227	2,104	2,955	0,598	17,500	22	CRMS	**3**	Under 19 years old
2,525	69,056	3,685	175,920	1,710	3,560	0,500	17,400	25	CAHH		
4,702	66,500	4,147	174,191	2,010	3,274	0,544	17,447	47	**total**		
4,756	66,570	5,635	175,800	1,012	2,240	0,500	17,600	25	NRBBO	**5**	
3,586	64,058	5,635	175,038	1,003	2,731	0,400	17,700	26	WARD		
4,159	65,289	4,459	175,412	1,206	2,490	0,483	17,647	51	**total**		

Research Variables:

Independent Variable:

The independent variable is the variable that the researcher controls in scientific experiments to determine its effect on the dependent variable. The researcher increases or decreases its value to observe its impact on the dependent variable (Al-Rufu', 2016, p. 18.(

The independent variable is athletic training in football. The training was adjusted according to the training age of the players, who were under 19 years old.

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Dependent Variables: A dependent variable is defined as the variable that changes under the influence of the independent variable. The dependent variables in our study are the physiological variables related to the cardiovascular system, namely:

-Resting heart rate. - Exercise heart rate. - Recovery heart rate. - Resting blood pressure. - Exercise blood pressure. - Recovery blood pressure.

The Mediating (Modifying) Variable:

The mediating variable can be defined as "the variable through which the independent variable affects the dependent variable" (Sa'ati, 2014, p. 60). It is "the variable that influences the relationship between the independent and dependent variables." The mediating variable is the training variable, which was adjusted through its evaluation and includes:

a. Training Age: This was divided into three levels, as most previous studies have done, in addition to using the arithmetic mean of the training age and the recorded standard deviation. The results were as follows:

-Level 1: 0 to 1 year

-Level 2: 2 to 3 years

-Level 3: More than 3 years.

Table No. (03) shows the distribution of the sample according to training age

level	Number of players under 19 years old	Training age for the level
Level 1	37	From 0 to 1 year
Level 2	41	From 2 to 3 years
Level 3	20	Over 3 years

Pilot Study:

The first pilot study was conducted on 19 under-19 football players. The objectives of the study were:

-To investigate the suitability of the selected tests in order to determine their validity, reliability, and objectivity.

-To ensure the safe application of the programmed tests in the main experiments, including the measurement procedures, instruments, and devices used, and to identify any shortcomings that might appear during the tests in order to address and prevent their recurrence during implementation.

-To train the support team on data recording using the prepared forms.

The test-retest method was used to calculate the reliability coefficient using Pearson's simple correlation coefficient and Spearman's rank correlation coefficient, based on the normality of the data distribution. Self-validity was calculated by taking the square root of the reliability coefficient. The following table shows the physiological measurements, units of measurement, reliability coefficient, and self-validity:

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Table (04): Shows the Reliability Coefficient and Face Validity of the Research Variables.

Validity Coefficient	Reliability Coefficient	Retest		Test		Unit of Measurement	Variable Name
		±S	$\bar{x}$	±S	$\bar{x}$		
0,960	0,921)b(	3,041	67,84	4,082	68,000	beats/minute	Heart rate – Rest
0,936	0,876) a(	3,330	120,26	4,369	121,26	mmHg	Systolic blood pressure – Rest
0,949	0,901) a(	3,096	77,578	3,847	77,631	mmHg	Diastolic blood pressure – Rest
0,941	0,886) a(	5,786	115,47	7,812	113,42	beats/minute	Exertion heart rate
0,946	0,894) a(	5,118	124,05	5,449	123,42	mmHg	Exertion systolic blood pressure
0,947	0,897)b(	4,581	79,105	5,099	79,684	mmHg	Exertion diastolic blood pressure
0,971	0,944) a(	7,050	86,526	9,247	85,789	beats/minute	Heart rate 1 min after exercise
0,911	0,831) a(	4,497	124,68	4,660	122,94	mmHg	Systolic blood pressure 1 min after exercise
0,955	0,913) a(	3,287	75,157	3,519	74,947	mmHg	Diastolic blood pressure 1 min after exercise

(a) Pearson's simple correlation coefficient. (b) Spearman's rank correlation coefficient.

Table (18) shows that all measurements have a high reliability coefficient ranging from 0.8310 to 0.944, as well as a high degree of self-validity ranging from 0.911 to 0.971.

Objectivity of the tests and measurements: All tests and measurements are simple and easy to understand, and are free from subjective evaluation by assistants. Recording and evaluation are based on time units and the number of repetitions. Furthermore, the instruments used for measurement are highly accurate. These tests and measurements have been approved and validated in previous and similar studies, as well as by cardiologists, thus demonstrating their high objectivity

Research Methods and Tools:

Equipment and Tools Used:

The researcher used a set of equipment and tools to assist in data collection, as follows:

1. .An OMRON medical scale measuring weight to the nearest 50g.
2. Four OMRON electronic blood pressure monitors.
3. A SONY electronic stopwatch measuring to the nearest 1/100th of a second.
4. Four chairs.
5. A whistle.

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6. Paper notebooks with a data collection form.

7. A stameter for measuring total body height.

Data Collection Methods:

Data was collected through the analysis of scientific sources, research, and similar studies directly related to the research topic. Tools and equipment were used, along with a team of assistants. The researcher employed a set of measurements and tests that met scientific standards and possessed a high degree of validity, reliability, and objectivity. These methods have been used by numerous experts and researchers and have yielded the desired results in measuring the various research variables.

Ruffier Test:

Test Objectives: To measure the efficiency of the heart and circulatory system during exertion and at rest, and to assess the speed of cardiac recovery after minimal physical activity.

Measurement Steps:

1. Resting Pulse Measurement:

✓ Sit quietly for 5 minutes.

✓ Measure the heart rate for 15 seconds using a stopwatch.

✓ Multiply the value by 4 to obtain the heart rate in beats per minute.

✓ This value is designated as P1. 2. Perform 30 squats:

✓ Stand with your knees bent and lower yourself into a full squat.

✓ Repeat the movement 30 times within 45 seconds.

2 .Measure your pulse immediately after the activity:

✓ Immediately after completing the squats, measure your pulse for 15 seconds.

✓ Multiply the reading by 4 to get your heart rate in beats per minute.

✓ This value is denoted as P2.

3 .Measure your pulse after one minute of rest:

✓ Rest completely for one minute.

✓ Measure your pulse for 15 seconds.

✓ Multiply the reading by 4 to get your heart rate in beats per minute.

✓ This value is denoted as P3. (al, 2017, p3 & Zanevskyy) Correction equation: IR = (P1 + P2 + P3) / 10 where IR is the Ruffier index.

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Analysis of Results:

5 – 0 **10 – 6** **15 – 11** **16 <**	**Excellent efficiency** **Good efficiency** **Average efficiency** **Poor efficiency**

Statistical Methods Used in the Research:

The researcher used the SPSS statistical package (version 24) and included the following statistical methods:

*Arithmetic mean. - Standard deviation. - Percentage. - Shapiro-Wilk test. - Moschley test for sphericity.

*Friedman test. - Simple analysis of variance (ANOVA).

*Repeated measures analysis of variance with sphericity correction (Huynh-Feldt).

*Two-way ANOVA with Bootstrap testing to ensure the accuracy of the statistical results.

*Kruskal-Liss test. - Wilcoxon signed-rank test. - Tukey's test. - Scheffé test. - Mann-Whitney U test.

*Simple correlation coefficient (Pearson's). - Spearman's rank correlation coefficient.

Discussion of Results:

Differences between Under-19 Football Players in Functional Variables According to Training Age Groups:

To determine the differences between under-19 football players in functional variables during (rest, post-exercise, and 1 minute post-exercise) according to training age groups, descriptive statistics (arithmetic mean, standard deviation, and Shapiro-Wilk test) were used to identify the most appropriate test for statistically determining differences. The results are shown in the following table**:**

Table (05): Shows the descriptive statistics of functional variables for players under 19 years of age according to training age categories.

The appropriate difference test	**result**	**Probability of testing Shapiro-Wilk**	**Descriptive statistics**			Training age (years)	Variable Name
			±S	**$\bar{x}$**	**Sample size**		
Analysis of variance for independent groups	N.D	0,07*5	4,04	70,95	37	01	Heart rate – Rest
	N.D	0,541*	4,14	68,41	41	02	
	N.D	0,22*6	3,29	68,10	20	03	
Analysis of variance for independent groups	N.D	0,15*4	5,86	118,68	37	01	Systolic blood pressure – Rest
	N.D	0,471*	5,92	119,51	41	02	
	N.D	0,59*7	7,04	115,95	20	03	
Analysis of variance for	N.D	0,057*	7,59	72,65	37	01	
	N.D	0,24*1	6,43	71,00	41	02	

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independent groups	N.D	0,626*	6,65	68,40	20	03	Diastolic blood pressure – Rest
Kruskal-Wallis	N.D	0,292*	10,07	90,11	37	01	Exertion heart rate
	N.N.D	0,001	9,44	82,22	41	02	
	N.D	0,82*9	4,27	78,45	20	03	
Kruskal-Wallis	N.N.D	0,037	7,47	125,24	37	01	Exertion systolic blood pressure
	N.N.D	< ,0001	7,97	126,27	41	02	
	N.N.D	0,0004	5,15	120,45	20	03	
Analysis of variance for independent groups	N.D	0,520*	6,80	76,65	37	01	Exertion diastolic blood pressure
	N.D	*0.286	6,05	74,41	41	02	
	N.D	0,943*	5,08	72,35	20	03	
Kruskal-Wallis	N.N.D	0,001	9,17	75,89	37	01	Heart rate 1 min after exercis
	N. N.D	0,001	9,34	74,44	41	02	
	N.D	0,568*	5,11	71,15	20	03	
Kruskal-Wallis	N.D	*0.482	6,78	120,62	37	01	Systolic blood pressure 1 min after exercise
	N. N.D	< ,0001	10,43	121,95	41	02	
	N.D	*0.710	4,62	117,45	20	03	
Kruskal-Wallis	**N.** N.D	**0.010**	**6,05**	72,19	37	**01**	Diastolic blood pressure 1 min after exercise
	N.D	0,380*	4,38	71,27	41	02	
	N.D	0,402*	5,05	69,70	20	03	

Significant at 5% error. Normalized ratio: Normally distributed. Non-normalized ratio: Not normally distributed.

Based on Table (05), which shows the descriptive statistics for functional variables in players under 19 years of age according to their training age, the Analysis of Variables (ANOVA) test for independent groups will be used to find differences according to training age groups (01-02-03) for functional variables (resting heart rate, resting systolic blood pressure, resting diastolic blood pressure, and post-exercise diastolic blood pressure). The Kruskal-Willis test will also be used to find differences among players under 19 years of age according to training age groups (01-02-03) for functional variables (resting heart rate, systolic blood pressure, and diastolic blood pressure) at rest, after exertion, and after one minute of rest. The results of the differences are shown in the following table:

Table (06): Shows the results of differences in functional variables for players under 19 years of age according to training age categories.

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result	Effect size	Probability of test	Descriptive statistics				Variable Name
			±S	$\bar{x}$	Sample size		
Significant difference at 1%	0,098)c(	0,007(a)	4,04	70,95	37	01	Heart rate – Rest
			4,14	68,41	41	02	
			3,29	68,10	20	03	
Non-significant difference	-	0,106(a)	5,86	118,68	37	01	Systolic blood pressure – Rest
			5,92	119,51	41	02	
			7,04	115,95	20	03	
Non-significant difference	-	0,092(a)	7,59	72,65	37	01	Diastolic blood pressure – Rest
			6,43	71,00	41	02	
			6,65	68,40	20	03	
Significant difference at 1‰	(d)0,203	(b)< ,0001	10,07	90,11	37	01	Exertion heart rate
			9,44	82,22	41	02	
			4,27	78,45	20	03	
Significant difference at 1‰	0,119)d(	0,003(b)	7,47	125,24	37	01	Exertion systolic blood pressure
			7,97	126,27	41	02	
			5,15	120,45	20	03	
Significant difference at 5 ‰	0,065)c(	0,041(a)	6,80	76,65	37	01	Exertion diastolic blood pressure
			6,05	74,41	41	02	
			5,08	72,35	20	03	
Non-significant difference	-	0,179(b)	9,17	75,89	37	01	Heart rate 1 min after exercis
			9,34	74,44	41	02	
			5,11	71,15	20	03	
Non-significant difference	-	0,090(b)	6,78	120,62	37	01	Systolic blood pressure 1 min after exercise
			10,43	121,95	41	02	
			4,62	117,45	20	03	
Non-significant difference	-	0,182(b)	6,05	72,19	37	01	Diastolic blood pressure 1 min after exercise
			4,38	71,27	41	02	
			5,05	69,70	20	03	

(a) Analysis of variance (ANOVA) for independent groups. (b) Kruskal-Willis test. (c) Eta-Squared (η^2) test.

(d) Epsilon-Squared (ε^2) test.

Table (06), which shows the results of the differences between players under 19 years of age in functional variables according to training age groups, reveals the following:

*For the resting-state variables, the independent groups' p-value for the resting heart rate variable (0.007) is less than the 1% margin of error. Therefore, there is a statistically significant difference between athletes under 19 years old in the resting heart rate variable according to their training age groups. The effect size (Eta-squared (η^2)) of 0.098 falls within the range of 0.060–0.139, indicating a moderate effect size. However, the independent groups' p-values for the resting-state variables (systolic and diastolic blood pressure) (0.106 and 0.092, respectively) are greater than the 5% margin of error. Therefore, there is no statistically significant difference between athletes under 19 years old in these variables according to their training age groups.

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*Regarding the post-exercise variables, the Kruskal-Willis test p-values for the two variables (post-exercise heart rate and post-exercise systolic blood pressure), which are <0.0001 and 0.003 respectively, are significant at a margin of error of 1‰. Therefore, there is a significant difference between athletes under 19 years of age in the post-exercise functional variables (post-exercise heart rate and post-exercise systolic blood pressure) according to their training age groups. Furthermore, the Epsilon-Squared(ε^2) effect size for the variables (post-exercise heart rate and post-exercise systolic blood pressure), which are 0.203 and 0.119 respectively, falls within the range [0.08–0.259], indicating a moderate effect size. Additionally, the independent groups ANOVA p-value for the variable (post-exercise diastolic blood pressure), which is 0.041, is less than the margin of error. 5%, indicating a significant difference between athletes under 19 years of age in the variable (post-exercise diastolic blood pressure) according to their training age groups. Furthermore, the effect size value (Eta-Squared (η^2)) (0.065) falls within the range [0.060-0.139], meaning the effect size is moderate. Therefore, there is a significant difference between athletes under 19 years of age in the variables (post-exercise heart rate, post-exercise systolic blood pressure, and post-exercise diastolic blood pressure) according to their training age groups.

*For the variables at 1 minute post-exercise, the Kruskal-Willis test probability values for the variables (heart rate 1 minute post-exercise, systolic blood pressure 1 minute post-exercise, and diastolic blood pressure 1 minute post-exercise), which are 0.179, 0.090, and 0.182 respectively, are greater than the 5% margin of error. Therefore, there is no statistically significant difference between the pairs of players under 19 years of age in the functional variables (heart rate, systolic blood pressure, and diastolic blood pressure 1 minute post-exercise) according to their training age groups.

Figure (10) illustrates the differences between pairs of players under 19 years of age in the functional variables according to their years of training.

To determine the differences in favor of the training age groups in the functional variables of players under 19 years of age, the Least Significant Difference (LSD) test and the Steel, Dwass, Critchlow and Fligner test will be used for the differences between pairs for the training age groups [(01-02), (01-03), (02-03)], and the following table shows this.

Table (07): Shows the results of the differences between pairs for the training age groups of players in functional variables.

Effect size Cohen d	**result**	**Probability test of the difference for pairs**	**Arithmetic mean** Exertion heart rate	**(Arithmetic mean (A) – Arithmetic mean (B)**	**Pairs**	**variables**
0,6414	S.D at 1%	0,006 (a)	70,95	2,53**	02 – 01	Heart rate – Rest
0,7211	S.D at %5	0,011 (a)	68,41	2,85*	03 – 01	
-	N. S.D	0,771 (a)	68,10	0,31	03 – 02	
-	S.D at 1%	0,003 (b)	90,11	7,89**	02 – 01	Exertion heart rate
-	S.D at 1%	<0,0001 (b)	82,22	11,66***	03 – 01	
-	N. S.D	0,566 (b)	78,45	3,77	03 – 02	
-	N. S.D	0,841 (b)	125,24	-1,03	02 – 01	
-	S.D at 5%	0,049 (b)	126,27	4,79*	03 – 01	

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-	S.D at 1%	0,001 (b)	120,45	5,82***	03 – 02	Exertion systolic blood pressure
-	N. S.D	0,114 (a)	76,65	2,23	02 – 01	Exertion diastolic blood pressure
0,6967	S.D at 5%	0,014 (a)	74,41	4,30*	03 – 01	
-	N. S.D	0,223 (a)	72,35	2,06	03 – 02	

*Significant at 5% error, **Significant at 1% error, ***Significant at 1‰ error.

(a) Least Significant Difference (LSD) test, (b) Steel-Dwass-Critchlow-Fligner test. From Table (07), which shows the results of the differences in pairs for the training age groups of players under 19 years old in functional variables, the following is evident according to the variables:

*Regarding (resting heart rate), there is a significant difference in the pairs [(01-02), (01-03)]. This is because the probability of the LSD test, which is (0.006, 0.011) respectively, is less than the 1% error for the first pair (01-02) and less than the 5% error for the second pair (01-03). As for the pair (02-03), the difference is not significant because the probability of the LSD test, which is (0.771), is greater than The margin of error is 5%.

The statistically significant difference favored under-19 football players with two years of training experience compared to those with one year of training experience.

Similarly, the statistically significant difference favored under-19 football players with three years of training experience compared to those with one year of training experience.

*Regarding (heart rate - after exertion), a significant difference is found between the two pairs [(01-02), (01-03)]. This is because the probability of the "Dwass, Steel, Critchlow and Fligner" test, which is (0.003, <0.0001) respectively, is less than the 1% error for the pair (01-02) and less than the 1‰ error for the pair (01-03). As for the pair (02-03), the difference is not significant because the probability of the "Dwass, Steel, Critchlow and Fligner" test, which is (0.566), is greater than the 5% error. The statistically significant difference favored under-19 football players with two years of training experience compared to those with one year.

Similarly, the statistically significant difference favored under-19 football players with three years of training experience compared to those with one year.

*Regarding (systolic blood pressure after exertion), a significant difference was found between the pairs (01-03) and (02-03). This is because the probability of the Steele-Dwass-Critchlow-Fligner test (0.049 and 0.001, respectively) is less than the 5% margin of error for the pair (01-03) and less than 1‰ for the pair (02-03). However, for the pair (01-02), the difference was not significant because the probability of the Steele-Dwass-Critchlow-Fligner test (0.841) was greater than the 5% margin of error.

The significant difference favors under-19 football players with three years of training experience compared to players with one year of training experience. The differences were also significant in favor of under-19 football players with three years of training experience compared to players with one year of training experience.

*Regarding (exertion diastolic blood pressure), a significant difference was found in the pair (01-03) because the probability of testing the Least Significant Difference (LSD) of 0.014 is less than the margin of error of 5%. However, for the pairs (01-02) and (02-03), the difference was not significant because the probability of testing the LSD of 0.114 and 0.223, respectively, is greater than the margin of error of 5%.

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Therefore, the significant difference favors under-19 football players with three years of training experience compared to players with one year of training experience.

Discussion of Hypotheses:

Table (06), which shows the results of the differences between players under 19 years of age in functional variables according to their training age groups, reveals the following:

*Regarding the variables during the resting period, there is a significant difference between players under 19 years of age in the (resting heart rate) variable according to their training age groups, with a moderate effect size. There is no significant difference between players under 19 years of age at rest in the variables (systolic blood pressure and diastolic blood pressure) according to their training age groups.

*Regarding the variables after exertion, there is a significant difference between players under 19 years of age in the functional variables after exertion (post-exertion heart rate and post-exertion systolic blood pressure) according to their training age groups, and the effect size was also moderate.

*Regarding the variables at 1 minute post-exercise, no significant difference was found between players under 19 years of age in the functional variables (heart rate, systolic blood pressure, and diastolic blood pressure at 1 minute post-exercise) according to their training age groups.

Table (07), which shows the results of the differences in pairs for training age groups of players under 19 years of age in functional variables, reveals the following:

*Regarding (resting heart rate), a significant difference was found in the pairs [(01-02) and (01-03)]. The significant difference favored football players under 19 years of age with two years of training experience compared to players with one year of training experience.

Similarly, significant differences were found in favor of football players under 19 years of age with three years of training experience compared to players with one year of training experience.

The significant differences also favored football players under 19 years of age with three years of training experience compared to players with one year of training experience. * Regarding (heart rate – after exertion), a significant difference was found in the pairs [(01-02), (01-03)]. The significant difference favored under-19 football players with two years of training experience compared to those with one year of training experience.

Similarly, the significant differences favored under-19 football players with three years of training experience compared to those with one year of training experience.

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